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COMPARATIVE LARVAL GROWTH OF THE VARIEGATED CUTWORM, *PERIDROMA SAUCIA*, FROM A LABORATORY COLONY AND A WILD POPULATION

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Abstract

Larval growth of variegated cutworms from a laboratory colony (maintained for over 12 generations) was compared with that of the F_1 generation of field-collected larvae on an artificial medium. After eleven days of feeding, larvae from the wild population weighed, on average, over three times as much as those from the laboratory colony. However, when larvae from each population were reared on media spiked with an inhibitory plant extract, the degree of growth inhibition relative to their respective controls was equivalent.

INTRODUCTION

Insects from laboratory colonies are commonly used in both basic and applied research, especially in studies of pesticidal efficacy where large numbers of uniformly aged individuals are required for bioassay. One implicit assumption underlying such studies is that the response of insects from the laboratory colony is representative of that expected of insects from wild populations. Unfortunately, maintenance of a laboratory colony of insects often results in inadvertent selection of genotypes and phenotypes which diverge from the colony founders of natural origin. Often this fact is overlooked, and the insects chosen for the study are those which can be conveniently produced in the laboratory setting (Berenbaum 1986).

In our laboratory, we have been using a laboratory colony of the variegated cutworm, *Peridroma saucia* (Hbn.)(Lepidoptera: Noctuidae), for bioassay of natural insecticides and antifeedants (Isman and Proksch 1985). This species was selected because it is a polyphagous pest of occasional economic importance throughout North America (Simonet *et al.* 1981), and because it is relatively easy to maintain in the laboratory in continuous culture. In the present study, we compared larval growth and survival of cutworms from a two-year-old laboratory colony with those of the F_1 generation of field-collected larvae.

MATERIALS AND METHODS

The laboratory colony, maintained for over 12 generations, was founded from pupae supplied by Dr. G. Ayer, Agriculture Canada, Winnipeg. They were taken from a laboratory colony maintained at Winnipeg for at least one year. The field population in our study consisted of the offspring of larvae collected from cabbage plants growing at the Department of Plant Science field laboratory on the University of British Columbia campus in Vancouver, as well as from unsprayed gardens in the Kitsilano district.

Larvae were reared on an artificial medium (BioServ Inc., Frenchtown, NJ, no. 9682) as described previously (Isman and Rodriguez 1983). In the first experiment, neonate larvae from each population were reared on the standard diet for 11 days and then weighed. In the second experiment, neonate larvae from each population were reared on either the standard diet treated with 95% aqueous ethanol, or a diet spiked with an ethanolic extract from foliage of big basin sagebrush, *Artemisia tridentata,* at 50% of natural concentration (dwt/dwt). For each

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treatment group, 30 neonate larvae were reared individually in 30 mL plastic cups with a diet cube of approx. 1 g fwt. The cups were placed in a plastic box lined with moistened paper towels to maintain high relative humidity, and the box was placed inside a growth chamber at 27° and 16:8 LD. Larvae were again weighed following 11 days of feeding.

RESULTS AND DISCUSSION

The results of the first experiment are shown in Table 1. Cutworms from the wild population were almost three times heavier after 11 days than were larvae from the laboratory colony. Although we did not collect precise data, larvae from the wild population pupated earlier and produced heavier pupae than their cohorts from the laboratory colony. These results suggest that the laboratory environment may have either selected for slower growing and smaller individuals or may have a general fitness-reducing effect. If larval growth rates are linked to alleles present in wild populations, the quality of laboratory colonies may be improved by careful introduction of wild stock to the colony, a practice which is frequently done (Berenbaum 1986). On the other hand, introduction of wild stock may also introduce natural disease to the laboratory colony. Natural populations of *P. saucia* are known to harbor a nuclear polyhedrosis virus (Harper 1970), which requires labor-intensive precautions to manage it if introduced to the laboratory colony.

Table I. Mean larval weight (S.D.) of neonate varigated cutworm, *Peridroma saucia,* feeding on artificial diet for 11 days.

Source	n	Larval weight (mg)
Laboratory	66	63.7 (21.5)a[1]
Field	66	183.6 (34.6)b

[1] Means followed by the same letter are not significantly different, $F_{(0.05,1,130)}=571.8$

Larval growth is one important determinant of fitness for an insect population. Plants produce a plethora of natural chemicals which are capable of inhibiting larval growth when admixed with artificial media (e.g. Freedman *et al.* 1979). We established that among extracts of weedy Asteraceae growing in British Columbia, those of *A. tridentata* were extremely inhibitory to growth of variegated cutworms (Salloum and Isman 1988).

The results of the second experiment, including diets spiked with an extract of *A. tridentata*, are shown in Table 2. This bioassay confirmed that larvae from the wild population grew faster than those from the laboratory colony. However, the plant extract was equally inhibitory to both populations of cutworms, inhibiting larval growth by approximately 75% relative to controls in each case (Table 2). This latter result suggests that relative comparisons of growth inhibition from our laboratory colony appear to be valid. It justifies the continued use of our laboratory colony as a bioassay tool for screening additional plants and pure plant chemicals in the search for potential pest control materials.

Table II. Mean larval weight (S.D.) of an F_1 field collected population of *Peridroma saucia* compared to the laboratory colony fed the standard diet and diet containing a growth inhibitor[1].

Diet treatment Larval culture	%Survival (n=30)	Mean larval weight (mg)	%RC[2]
Standard diet			
Lab colony	90	56.9 (27.9)	
Field colony	100	136.6 (43.6)	
Growth inhibitor diet			
Lab colony	90	13.5 (8.7)	23.7
Field colony	80	34.8 (14.7)	25.5

[1] 50% ethanolic extract (dwt/dwt) from big basin sagebrush, *Artemisia tridentata*
[2] % of respective control fed standard diet

Two-way Analysis of Variance

Source of Variation	DF	SS	F	Probability
Model	3	16.9	25.6	0.0001
between populations	1	8.3	37.8	0.0001
between diets	1	7.5[a]	34.0	0.0001
popul. * diets	1	0.2	0.8	0.3833
Error	104	22.9		

[a] Sum of squares of larval growth are adjusted for mortality

It should be noted that our results may not necessarily be applicable to other species. A recent evaluation of resistance in Bermuda grass, *Cynodon dactylon,* to the fall armyworm, *Spodoptera frugiperda*, indicated that two laboratory strains of the pest of different geographic origins responded quite differently to four varieties of the host plant tested (Pashley *et al.* 1987). Such results indicate that investigators employing laboratory colonies should periodically compare bioassay performance of their test species to that of wild conspecifics.

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FORAGING BEHAVIOR OF HONEY BEES ON MANCHURIAN CRABAPPLE AND RED DELICIOUS APPLE[1]

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Abstract

'Manchurian' crabapple pollinizer trees bloomed several days before red 'Delicious' trees. Of the honey bees collecting nectar, 98% foraged from the top of 'Manchurian' flowers but only 44% topworked 'Delicious' flowers. Topworkers spent less time per flower on 'Manchurian' than on 'Delicious'. Individual bees foraging from the side of the flower on 'Delicious' spent even less time per flower than topworkers.

INTRODUCTION

'Delicious' apple (*Malus sylvestris* Mill.) requires cross-pollination before setting fruit, so suitable pollinizer varieties must be planted throughout the orchard. Honeybee (*Apis mellifera* L.) pollinators are recommended for pollen transfer between varieties. The number and placement of pollinizer trees required for best production are largely determined by the foraging habits of honeybees, which tend to work along tree rows rather than cross the aisle spaces (Mayer *et al.*, 1986). Good pollinizers must bloom at the same time and have pollen compatible with the main variety. In addition, bee behavior must be compatible between varieties.

Pollinizers planted as every third tree in every third row ensure that each main-variety tree is adjacent to a pollinizer but minimizes the number of pollinizers. Having every second tree in every row a pollinizer ensures maximum pollination, but is not economically practical.

Pollinizers take up usable production space in the orchard. An alternative planting arrangement being tested in apple orchards uses flowering crabapples. (Williams and Church, 1983; Mayer *et al.* 1986). Crabapple pollinizers are planted between main variety trees every 72 to 120 m in each row with adjacent rows offset. They take up minimal space and their sole function is to provide pollen. Honey bee behavior on crabapple pollinizers and main varieties must be compatible for maximum pollination. The objective of this study was to compare the foraging behavior of honeybees on 'Manchurian' crabapple and 'Delicious'.